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Cover

Historic Moment in Space Shuttle Testing—The fifth and final free-fall test of the Space Shuttle orbiter took place Oct. 27 at the Dryden Space Flight Center. This photograph shows the 747 and orbiter just before separation took place, with three of six chase planes in view. Below is the harsh but beautiful terrain of the Mohave Desert and the hills surrounding the test area.

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Letter from Washington

Dear Colleagues:

The heavens declare the glory of God; and the firmament showeth his handiwork.

Day unto day uttereth speech, and night unto night showeth knowledge. (Psalms 19:1,2)

Throughout history, and before the history we know, the order and the glory of the planetary system and of the stars have been the sign of order in the universe and the inspiration of religion and of strivings for better order in human life.

As we look outward on the universe, sending instrument extensions of ourselves beyond where we can yet go, let us also consider how we may create a better order within and among us, so that the knowledge and power we gain may be used for the best advantage of us all.

We in NASA share the special privilege of working toward understanding the universe and learning how to use that understanding.

The year 1977 has been one of accomplishment for our agency, marked, among other things, by the continued success of the Viking Mars explorations, the completion of the Space Shuttle approach and landing tests, the initiation of the Voyager odysseys, the beginning of HEAO and ISEE operations, numerous significant technological developments for aeronautical and space applications, and the continuous flow of that technology into other sectors of society to the general benefit of the human lot.

As NASA people, as government employees, as Americans, we have every reason to celebrate a year filled with progress for our country, a progress to which we have personally contributed. My own satisfaction in this season is to be the leader of the legendary NASA team with its immense potential for the advancement of science and the improvement of human life on our planet.

I wish all of you in the NASA family the joyous and restorative holiday season you have so clearly earned and I look forward with you to another year of achievement for people everywhere.

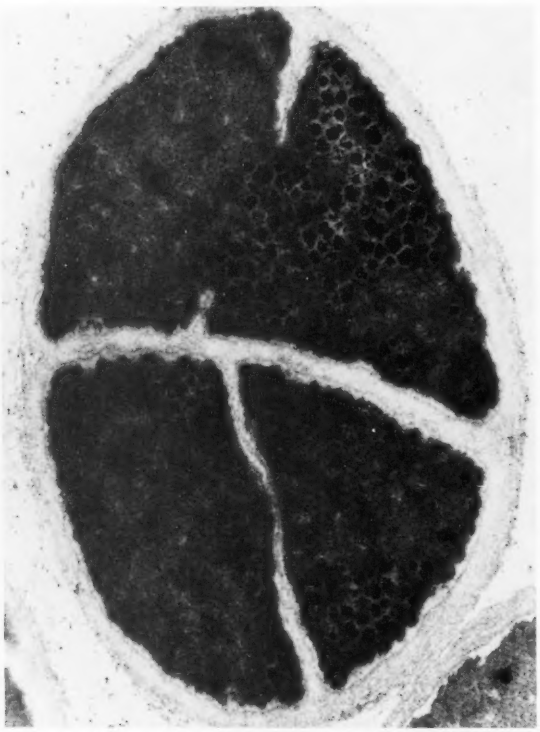
Sincerely,

Robert A. Frosch

Research Uncovers a Third Life Form

Biologists working for NASA and the National Science Foundation have identified a "new" form of life on Earth, possibly dating back to the planet's first billion years. The new form, previously thought to be a type of ordinary bacteria, is a methane-producing organism representing a line of evolutionary descent that is totally separate from the two traditionally recognized lines—animals and plants, and bacteria. The organisms may be the oldest of life forms as well—coming not only before plants and animals but also before bacteria.

The finding was made by a research team headed by Dr. Carl Woese, Professor of Genetics and Development at the University of Illinois at Urbana. He is an evolutionist and world expert on the genetic code.



"New" Life Form—This picture, taken with an electron microscope, show a cross-section of one of the organisms identified by a NASA-NSF team of biologists as a "new" form of life on Earth, possibly dating back to the planet's first billion years.

"The organisms are a distinct new class, no more related to typical bacteria than to higher forms," say the researchers. "They are a third form of life on this planet."

Methane-producing organisms appear to be ideally suited to what scientists believe to have been the Earth's primitive atmosphere in that:

- They can get all their food and energy from very simple compounds such as carbon dioxide and hydrogen, the main gases in a primitive atmosphere.
- They do not use any of the complex chemicals most other organisms require as food, such as sugars and amino acids.
- Certain of the species grow best at high temperatures, in the range of 65 to 70 degrees Celsius.
- They now can be found only in niches swept clean of oxygen, such as those deep in some of the hot springs at Yellowstone National Park.
- The researchers said the discovery creates new hope that science will ultimately find out a great deal about how life came about on this planet, and therefore be in a better position to also understand and discover life forms that may have evolved elsewhere in or beyond the solar system.
- For a long time, many biologists have felt that all life on Earth came from a common ancestor. Over the past decade, considerable evidence in support of that view has accumulated. Not known, however, was either the nature of this common ancestor (except that it obviously had to be an extremely simple form) or the original branchings into the various lines of evolutionary descent.
- It is generally assumed that the two lines of descent from the common ancestor were represented by (1) the higher forms (animals and plants) and (2) the lower form (bacteria). A third form of life was an idea never seriously entertained by biologists.

The circumstances surrounding identification of yet a third form began with methane gas experiments. For several decades, biologists have been working with a group of organisms that produce methane as their main waste product. But since the organisms are so infinitesimal, it had been taken for granted that they were ordinary bacteria. Until recently, no one had suspected that these methane producers represented a line of descent from a common ancestor that is completely separate from the two traditionally recognized lines.

(According to presently accepted ideas, the Earth, along with the Sun and the other planets, was formed about 4.6 billion years ago. The earliest forms of life yet discovered on Earth bacteria and simple plants—have been found in rocks laid down when the Earth was a billion or more years old. According to the fossil record, about one billion years ago wormlike creatures appeared, and 400 million years ago the first fishes waddled out of stagnant ponds onto land. From these descended the reptiles. Branches of the reptile family gave rise to dinosaurs, birds and mammals. The ancestors of modern man appeared approximately two million years ago.)

Since the primeval evolutionary branchings probably occurred during the first billion years of the Earth's existence, there is no hope of finding a fossil record of them, inasmuch as they existed before the oldest rocks on Earth were formed. But the living cell, in a sense carries a partial record of its past in its own genes, and over the past two decades, scientists have developed ways of partially deciphering these ancient genetic texts. (The measurement is actually done by determining how different from one another two "versions" of the same "text" are; the greater their difference, the further back their respective lines of descent are separated from each other.)

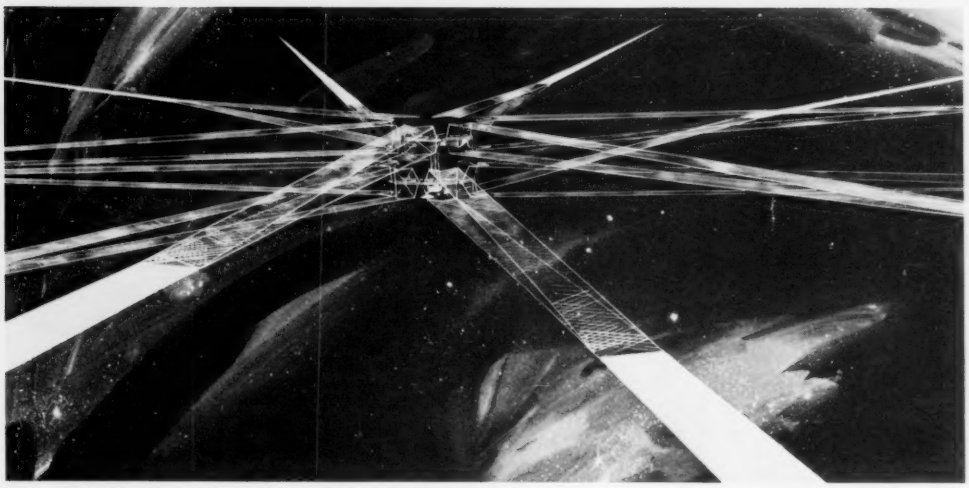
Through analysis of a very ancient and highly conserved portion of this genetic record, known as ribosomal RNA, investigators have been able to uncover evidence of events that occurred during the first billion years of Earth's existence. By this means, the genealogy of the methane-producing organisms was shown to be distinct from both the typical bacterial and the animal-plant genealogies.

Three to four billion years ago, the Earth's atmosphere contained no oxygen. It is thought too, that carbon dioxide, hydrogen and other gases formed the atmosphere. Our explorations of the Moon have revealed that its surface (and so, by inference, the Earth's) was extremely hot in its early stages. Life would have begun when our planet had cooled sufficiently to support its existence, but was still far warmer than in subsequent eons. Dr. Woese notes that methane-producing organisms are best suited to such conditions.

Woese believes that the recent findings may provide knowledge of one of the missing stages of evolution, the chemical stage which immediately preceded the stages of life as we know it. At present, an enormous gap exists in our understanding, according to the researchers.

Woese's principal collaborator in the study was Dr. George Fox, who has now moved to the University of Houston. The research team also included Woese's chief assistant Linda Magrum, and Kenneth Luehrsen, David Stahl and Ramesh Gupta, graduate students.

Woese's group collaborated closely with that of Prof. Ralph Wolfe, microbiologist at Illinois. William Blach, a student of Dr. Wolfe, also was a principal in the studies.



Solar Sailing Spacecraft—A heliogyro, or two-deck spinning solar sail is under continuing research at NASA's Jet Propulsion Laboratory as the choice vehicle for research in the use of free sunlight (photon) propulsion on trips into space as far as 100 million miles from Earth. Each of 12 blades of 0.1 mil coated plastic film would be more than seven kilometers long to provide maximum power for multi-year flights.

Results of Frosch's First European Visit Significant

In early October, Administrator Dr. Robert A. Frosch, concluded a week-long, highly successful first visit to Europe as Administrator. At a meeting with the Director General of the European Space Agency in Paris, the annual Spacelab program review was concluded. The $600 million European Spacelab development program was found to be proceeding well and on schedule for a 1979 delivery to NASA of the first Spacelab units, to be flown in 1980.

After visiting ESA headquarters in Paris, Frosch went to Holland, where he signed a cooperative agreement for the Infrared Astronomy Satellite project with Dutch space officials. IRAS will conduct the first astronomical survey of the entire sky at those infrared wavelengths undetectable by Earth-based telescopes because of the obscuring effects of the atmosphere.

Scheduled for launch in 1981, the Earth-orbiting observatory will employ a large infrared telescope furnished by the United States, a spacecraft built by the Netherlands, and a ground operations facility supplied by the United Kingdom. All three nations are participating in providing the scientific instrumentation of the satellite and in the observation program.

Frosch then visited Germany, where he signed with a cooperative agreement on the Jupiter Orbiter Probe with German space officials. This planetary exploration mission, scheduled for flight in early 1982, will be the first planetary spacecraft to be carried aboard the Space Shuttle.

The probe is designed to conduct the most detailed scientific investigation yet of Jupiter and its environment and moons, including the first direct measurements of the atmosphere of the planet. The mission is composed of an orbiter that will circle the planet for at least 20 months and a probe that will plunge deep into Jupiter's atmosphere. Under the agreement, Germany will provide a retro propulsion module designed for injection of the orbiter probe spacecraft into orbit around Jupiter. It also will provide not only selected scientific instruments for integration into the scientific payload, but the services of selected scientific investigators.

The several new cooperative agreements will result in total European expenditures of some $180 million in the three space science programs over the next few years.

Senior NASA officials accompanying Frosch on all or some of his visits were: Dr. Walter Williams, NASA's chief engineer; Arnold W. Frutkin, assistant administrator for international affairs; Walter P. Murphy, NASA's European representative; Douglas R. Lord, NASA director of the Spacelab program; and Richard J. H. Barnes, director for international planning and programs, office of international affairs.

Historic International Agreement Reached—At the Paris headquarters of the European Space Agency, NASA Administrator Dr. Robert A. Frosch and ESA Administrator General Roy Gibson signed a memorandum of understanding stating the terms for cooperation between the two agencies in the NASA Space Telescope Program. Seated at Dr. Frosch's right is H. Kantenecker, of ESA, at his left Gibson. Observers standing behind the three men are not identified.

Champion Crew—The 747 Shuttle Carrier aircraft crew completed 13 test flights at the Dryden Flight Research Center with the orbiter traveling piggyback, extending from February to November 1977. All were successfcl. The crew (left to right) consisted of pilot "Fitz Fulton; co-pilot Tom McMurtry; and Skip Guidry and Vic Horton, flight engineers.

New Associate Administrator Named

Dr. James J. Kramer became NASA's Associate Adminstrator for Aeronautics and Space Technology on Oct. 23, 1977 after serving as Acting Associate Administrator for OAST since Dec. 19, 1976.

In his new post, Kramer will be responsible for directing NASA research and technology programs to meet the nation's future requirements in aeronautics and space technology.

Kramer began his career at NASA's Lewis Research Center in 1951 and reported to NASA headquarters in 1971 as chief of the noise and pollution reduction branch of OAST. After a number of positions of increasing responsibility, he was appointed Acting Associate Administrator for OAST.

A native of Covington, Ky., Kramer received an A.B. in mathematics and physics in 1949 and his M.A. in mathematics in 1951—both from Xavier University, Cincinnati, Ohio. He was selected as a Princeton Fellow in Public Affairs, in 1973, and received an honorary Doctor of Laws degree from Xavier in 1975.

Among honors awarded to Kramer are the NASA Exceptional Service Medal in 1967, the Flemming Award in 1969 and the NASA Outstanding Leadership Medal in 1976.

Viking Guest Investigators

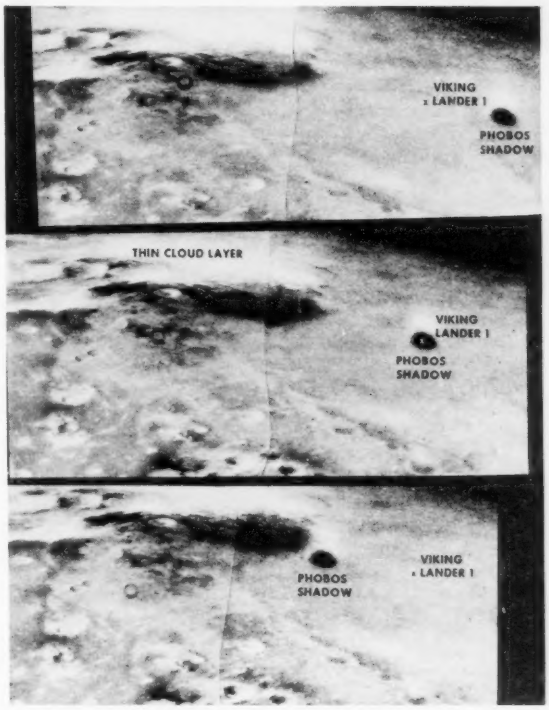
An experiment at NASA's Jet Propulsion Laboratory has used the shadow of the Martian moon Phobos to attempt to pinpoint the precise location of a Viking spacecraft on the surface of Mars.

The experiment of Thomas C. Duxbury is one of 20 chosen under a Viking guest investigator program established by NASA to provide experimental opportunities beyond those originally planned for the mission. Other experimentation involves science, mapping, atmospheres, Martian geology and chemistry, and imagery.

The United States landed two spacecraft on Mars in 1976 to conduct a detailed scientific examination of the planet, including a search for life. The landers' companion spacecraft, the Viking orbiters, have been circling the planet, taking pictures and making measurements.

Duxbury's experiment is basically an attempt to determine exactly where Viking Lander 1 is located in pictures of the landing site taken by the Viking orbiters. Scientists know where the lander is located in relation to space, but they cannot relate orbiter photographs of the landing site to that position. The margin of error may be as large as 10 kilometers, according to Duxbury. The spacecraft is too small to be seen by the orbiter cameras.

Duxbury "watched" the shadow of Phobos go over the landing site. As the shadow passed the lander, the lander and orbiter both were programmed to take a picture. Knowing the time when the picture was taken and the exact position of the shadow at the time gave Duxbury the opportunity to determine the location of the lander.



Locating Viking Lander on Mars—Shadows of the Martian moons, Phobos and Deimos, as they were used to pinpoint the position of NASA's lander on the surface of Mars. The pictures are the first (bottom), middle, and last (top) in a 40-picture series of the shadow of Phobos taken during a three-minute period. The shadow (about 90 km long), moved about 350 km from west to east across the surface of Mars. At the same time, Viking lander 1 took pictures as the shadow of Phobos crossed over it. Careful timing and detailed processing of these and similar Phobos/Deimos shadow pictures allow scientists to locate the lander within one km. Combining the moon photos with other data will allow scientists to find the lander's location within about 200 m.

"Fitz" Fulton Named Top Test Pilot

The Society of Experimental Test Pilots recently gave the Iven C. Kincheloe award as test pilot of the year—the highest the society gives—to Fitzhugh L. Fulton, Jr. for his efforts in the approach and landing tests phase of NASA's Space Shuttle. Fulton, a civilian test pilot for NASA's Dryden center, was honored for his outstanding professional accomplishment in piloting the 747 carrier plane which carried the Enterprise aloft in 13 test flights beginning last February and ending in mid-November.

Fulton also is flying the triple-sonic YF-12 plane for NASA. In the past, he has flown the XB-70 and has served as launch pilot for the X-15 and other research vehicles. A research pilot for NASA's Dryden center since 1966, he served for 23 years in the Air Force before that.

The "Test Pilot of the Year" award is the second top-level honor Fulton has received in his long flying career. He won the 1962 Harmon Trophy for his work as an Air Force project pilot on the B-58 Hustler test program at the Edwards Air Force base, which set an international altitude record. For his flight test work with the Air Force, Fulton has received three Distinguished Flying Cross medals, as well as an additional DFC and five Air Medals for 55 missions in Korea and for flying scores of humanitarian missions in transports during the Berlin Airlift of 1948-49.

Theories about Origin of Life Advanced at NASA Center

Scientists at NASA's Ames Research Center have uncovered an important factor in understanding the origin of life on Earth. Their research shows how building blocks of life may have been collected and organized on the shores of the primitive oceans by "natural catalysts" widely distributed on Earth—a possible key step in the chemical evolution of the first living organisms.

The Ames experiments demonstrate how two basic types of life molecules (amino acids, the building blocks of protein, and nucleotides, the building blocks of the life-directing DNA molecule) might have been concentrated in the primitive oceans. The research also shows how non-living amino acids can be selectively destroyed, and how life-related amino acids might have linked together in ancient oceans into the chains that formed living cells.

The manner in which random collections and small amounts of life-building blocks could have concentrated to eventually produce living organisms has long been a mystery to biologists.

Team leader for the work was Dr. James Lawless of the Ames center along with Dr. Nissim Levi, a National Research Council fellow from Israel, working at Ames. Their collaborators were Dr. Daniel Odom, now at the University of Houston, Kristi Kjos and Randy Mednick, both students at the University of Santa Clara, also working at Ames. Lawless gave a paper reporting on the work at the recent Pacific Conference on Chemistry in Anaheim, Calif.

Most scientists accept the theory that life began by chemical evolution on the shores of the primitive ocean. Theory claims that various forms of energy—such as lightning, heat and ultraviolet radiation—converted the abundant, carbon-containing ammonia, methane and water of the primitive Earth into building blocks of life (organic molecules). These molecules then joined together into ever more complex molecules until a molecule or group of molecules appeared which could replicate itself. This, say scientists, was the first living being.

In recent years, scientists have performed many chemical evolution experiments. These have produced most of the basic life molecules (including amino acids and nucleotides) in small quantities, by applying electrical discharges or other energy releases to ammonia, methane and water. But until now, scientists have been unable to explain how the life building blocks in the primordial oceans were organized.

The newly found mechanism involves substances which would have been common on the shores of the primitive oceans—metal clays. Clays had to be widely spread on the primordial Earth and ocean shores; and, by definition, all clays contain metals.

Without doubt, metal salts would have been present in the oceans. When low concentration solutions of amino acids were mixed with the commonplace metal clays—according to the theory that was the basis of the Lawless team's investigation—all clays attract amino acids (of which there are about a thousand different kinds) out of solution. (One metal clay (containing nickel) preferentially attracts the 20 amino acids which make protein, the main structural ingredient of living cells. Nickel clay is a highly abundant Earth material.) Of eight metal clays tested, only nickel clay performs in the manner described.

Experiments simulating tidal action on the clays—for example, drying an amino acid clay solution, warming it, wetting it again and repeating the process several times—produces chains of amino acids (eight amino acid molecules linked together, so far).

Presumably, time would produce the far longer chains found in life.

A metal clay had a similar effect on the building blocks of DNA. (The very long chain DNA molecule in every living cell, including human ones, contains a blueprint of the entire organism.) Of nine metal clays tried, only the zinc one concentrated DNA building blocks.

Lawless believes that the key role of metals in many biological processes is a result of having had many metals present since the beginning of the life process, and that the presence of metals in living systems today is the result of early prebiological chemistry.

NASA Executive Appointed to President's Reorganization Study

Joseph F. Malaga, Kennedy Space Center's director of administration and management operations, has been appointed to direct a Presidentially mandated reorganization study of Federal administrative services in Washington, D.C.

Malaga was named for the job by Jay Solomon, administrator of General Services, and James McIntyre, acting director, Office of Management and Budget. Solomon is chairman of a senior steering group given the task of conducting the study, which is to be carried out as part of President Carter's Reorganization Project.

The objective of the project is to improve the management and delivery of administrative services to Federal agencies. It will assess the roles of GSA and other agencies in the provision of services related to real and personal property, transportation, data processing, telecommunications and records management.

Malaga will serve as executive director of the administrative services project. His new assignment is scheduled to last six months, ending on March 31, 1978 at which time Malaga says: "I definitely plan to return to KSC."

Malaga was appointed to his KSC position in July 1975. He has been supervising the administrative management activities at the spaceport. He joined NASA in 1962 as resource planning specialist for the manned space flight program and subsequently served as the NASA director of resources analysis and as assistant NASA administrator for institutional management before assuming his present duties at KSC.

During Malaga's absence from the center, William M. Lohse will serve as acting director in his place. Lohse also functions as director of procurement, supply and transportation for the Kennedy Center.

New Chief Scientist at NASA's JPL

Dr. Rochus E. Vogt, professor of physics at the California Institute of Technology, was appointed chief scientist at NASA's Jet Propulsion Laboratory according to a recent announcement by JPL director Dr. Bruce Murray.

During the two to four-year assignment, Vogt will divide his time between NASA's JPL and the Caltech campus where he will continue research in the area of high energy astrophysics.

Murray said that, as JPL's chief scientist, Vogt will be a member of the NASA laboratory's executive council and will function as the focal point for JPL scientists and outside scientists who work with the laboratory.

A member of the Caltech faculty since 1962, Vogt has been chairman of the faculty for the past two years. Currently he is principal investigator for the cosmic ray experiment on the NASA-JPL Voyager 1 and 2 missions to Jupiter and Saturn and has been science investigator for cosmic ray experiments on other NASA space flights.

Vogt, 47, born in Germany, was graduated from Universitaet Heidelberg and later received his Master's Degree and Ph.D. in physics from the University of Chicago. He engaged in research at the University of Chicago's Enrico Fermi Institute for Nuclear Studies from 1953 to 1962.

Dr. Vogt is a fellow of the American Physical Society and holds membership in the American Geophysical Union, the American Association of Physics Teachers and the American Association for the Advancement of Science.

Undergraduate Students Important Adjuncts to NASA Headquarters

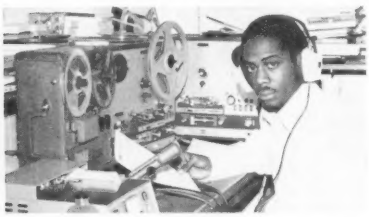
For the past 19 years, NASA has been a participant in a program designed to benefit young students, called the Cooperative Education Program. Generally, 20 to 30 students are assigned to summer work annually in various departments of NASA, one of many Federal and state government agencies that participates in the work-study program.

The philosophy behind the cooperative program from the student's standpoint is that it blends theory with practice and gives relevance to the classroom experience. Students are given an opportunity to test various work experiences and academic interests at a time when the accepting or rejecting of a career does not have the serious consequences it may have at a later date.

During the past year, NASA has helped to train 27 qualified undergraduates, sophomores to seniors. Candidates are selected on a competitive basis after one or two personal interviews after they have demonstrated both personal and academic accomplishments at their schools.

This year's crop of students worked in NASA departments such as the employee development office, personnel, office of internal affairs, public affairs and accounting. The group for 1977 represented a cross-section of the national population.

Cliff Woods, Jr., of NASA's office of personnel staffing, is coordinator for the program.



Micheal Banner, from Clark College, Atlanta, Ga., is employed in NASA's public affairs office.

Charlene Little, from East Carolina University, Greenville, N.C., at work in NASA's employment development office.

High-speed Sled Will Be Tested

Engineers at NASA's Marshall Space Flight Center have found a way to skip one phase of costly air-drop tests schedules for the Space Shuttle's recoverable solid rocket boosters. Instead, they will perform this testing on a sled in the New Mexico desert.

Two successful air-drop tests of this system have been conducted at the National Parachute Test Range at El Centro, Calif., where additional drop tests are planned. The air releases are made from a B-52 aircraft operating out of the NASA-Dryden Space Research Center.

Engineers have concluded that a high-speed ground sled test could provide the data they need in a later phase of the testing called "broadside deployment."

Originally, this test phase called for an air drop of a specialized vehicle configuration. Using the sled test approach, engineers believe the objectives can be better controlled, and at a cost savings.

Royce Mitchell, Marshall engineer in charge of the program, explained that the broadside deployment tests are necessary because the solid rocket boosters will "come in flat, or sideways, not like an arrow. The air flows across the nose cone more at right angles and we must be sure that the nose cap will separate and the recovery parachutes will deploy at this reentry angle," he said.

Mitchell explained that the nose cone would be mounted on the highspeed sled and tilted at a slight angle into the wind to allow the engineers to determine if the nose cap, when ejected, will clear the vehicle without entangling the recovery chutes.

The sled tests will be conducted at the Sandia sled track in Albuquerque.

Navajo Nation's Resources to Be Assessed

The Navajo Nation is preparing to use space technology in the form of a NASA earth resources satellite to assist it in managing natural resources on the 16-million acre Navajo reservation in the southwestern United States.

The Navajos asked NASA to investigate whether, through the use of satellite and aerial remote sensing techniques, Navajo resource inventory and management problems might be resolved.

An agreement was approved by both the Navajo Tribal Council (Window Rock, Ariz.) and NASA, which provides for members of the tribe and NASA to work together on a two-year project to establish a resource inventory for the Navajo reservation on

the basis of automated observations from NASA's Landsat.

Personnel of NASA's National Space Technology Laboratories, Earth Resources Laboratory, will assist the Navajos in field training and in the development of systems in the laboratory.

The project will be conducted in two phases: The first will demonstrate the utility of Landsat data to specific Navajo needs and applications and the ability of Landsat data to provide up-to-date information concerning the present status of various resources; the second essentially will be a transfer of technology and will include comprehensive training of Navajo personnel and the establishment of an operational system at the Navajo Nation headquarters at Window Rock. The program calls for Navajos to assist other Indian tribes to realize the benefits to be gained from similar information systems.

Landsat, circling the globe 14 times a day 912 kilometers overhead, surveys Earth natural resources with an electronic multispectral scanner that returns data for visual images and computer tapes from which experts can distinguish different types of terrain, vegetation, soils, rock outcrops and other surface features.

Besides mapping forests and possible mineral-rich areas, the data have been used for measuring crop acreages, charting snow cover, detecting oil slicks, mapping urban and agricultural land use, detecting offshore dumping of sewage and industrial wastes, monitoring the environmental effects of strip mining, and locating potential earthquake zones.

Landsat 1 has been in operation since July 1972 and a sister spacecraft, Landsat 2, since January 1975. A third one is planned for launch by NASA next year.

Ethnic Heritage Celebrated

So all employees might have an opportunity to recall their heritage and to share some of their personal history with their colleagues, the Kennedy Space center this year pioneered "Proclaim Your Heritage Week." The event also offered the chance to unify the previously recognized "Black History," "National Hispanic Heritage," and "Federal Women's" weeks.

Name tags were distributed to all employees, a move that encouraged them to proclaim their lineage, which in turn encouraged exchanges between employees regarding their individual backgrounds.

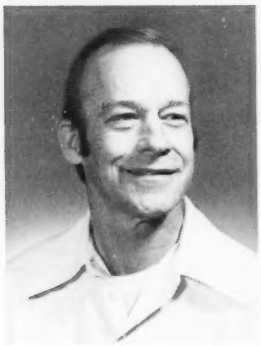
The keynote speaker at the three-day celebration was Dovey Roundtree, a noted Washington attorney. Other speakers included historians, an author and a management consultant.

Center employees from local square dance clubs presented grass roots lunch-time demonstrations complete with a professional square-dance caller.

A genealogical center was set up to help employees trace their own heritage. The week was judged a great success, and committee members hope to repeat it next year.

Swing Your Partner, Do Si Do—A lunch break at the Kennedy Space Center featured local square dancers during the recent "Proclaim your Heritage Week."

Federal Women's Opportunity Program Leaders Meet—Dovey Roundtree (right), well-known Washington attorney in criminal law, shakes hands with Kathleen Jenkins, FWOP coordinator (IRS) in Orlando; looking on is Stella Bell, FWOP coordinator for Orlando's Naval Training Center. The occasion was a three-day celebration held at the Kennedy Space Center.



Ed Browne, inspector

Space Shuttle First Test Stage Concluded

The world watched the beginning of a dream come true as the U.S. Space Shuttle moved from theory to reality in a series of trials during the past several months. Hundreds of NASA and contractor people formed a team that made the daring and complex venture seem almost commonplace as test after successful test was carried out.

Astronauts Fred W. Haise and C. Gordon Fullerton made a bouncy but successful landing of the Space Shuttle orbiter on its fifth and final free-fall flight test in late October on a hard surface runway at Edwards Air Force Base.

In their straight-in approach, which took only two minutes, Haise and Fullerton aimed for a touchdown about a third of the way down the runway and planned to bring the craft to a stop at the 3,000-m mark. That would be similar to landings of a Shuttle returning from orbit to the runway of the Kennedy Space Center. The pilots overshot their landing point by more than 300 m, but managed to steady the craft and stop it well before the end of the runway.

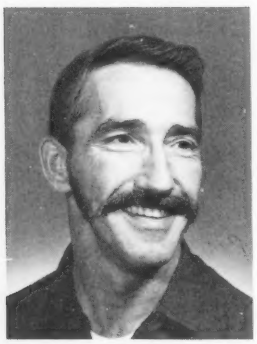
The *Enterprise* bounced back into the air after first hitting the runway and dipped a wing noticeably. It bounced at least two more times before settling down on the runway and rolling to a stop.

During a postflight press conference held at the Dryden Space Flight Center, Haise attributed the rough landing to higher-than-expected speeds during the final seconds, saying he had to "force" the *Enterprise* down onto the runway.

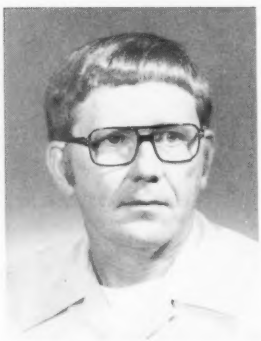
Chief of the Shuttle approach and landing tests Donald K. Slayton said at the same conference: "We have accomplished all the objectives we set out to accomplish. I'm very happy with the way it's progressed."

Bob Borek, range operations officer

Betty Callister, secretary to flight operations director

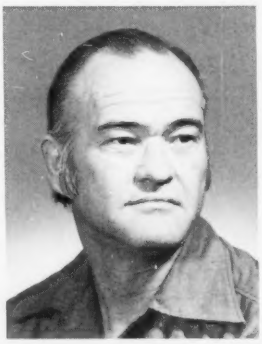


Glen Angle, inspector



Herb Anderson, 747 operations engineer

Trudy Tiedemann, Shuttle commentator *extraordinaire*



Al White, inspector

This was the first landing on a hard-surface runway and the second time the orbiter flew without its tailcone. The tailcone provided smooth airflow and reduced drag of the 747-orbiter combination during its climb to separation altitude. But orbiter astronauts reported the level as acceptable without its aid although the 747 tail surfaces were subjected to buffeting.

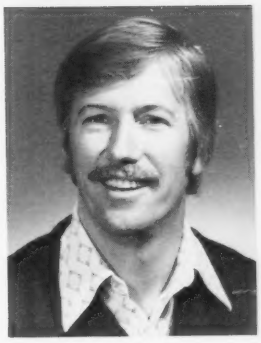
Inside the 747, pilot Fulton said the buffeting was not as much as anticipated. The damper located in the nose section of the jumbo jet was turned on to alleviate the lateral vibration caused by buffetting around the 747 tail. The damper can best be described as a 450-m, spring-loaded weight, and it did improve the ride up front.

In four additional tests that took place in November at the Dryden center, the mated aircraft underwent ferry-configuration flights. Then it was back to the barn, at Dryden until March, when the paired craft will fly to Huntsville, Ala. Marshall Space Flight Center personnel, under the direction of project manager Robert Lindstorm, will then subject the orbiter to a six-month-long series of ground vibration tests with rocket boosters and external tank attached.

In the interim between the final tests and delivery to Alabama, members of the Dryden team will continue to work on the orbiter, rewiring its electronics and completing other chores to ready the spacecraft for the next set of grueling trials, doing their utmost to prepare the *Enterprise* for additional successes as testing at Marshall continues.

Surrounding this text are photographs of some of the individuals from the Dryden center who gave unstintingly of their time, effort and enthusiasm to make Space Shuttle's debut and initial trials a brilliant success.

John McTigue, ALT deputy program manager

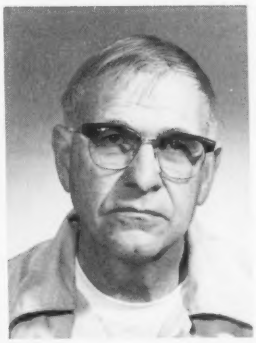


Jim Phelps, Shuttle carrier aircraft specialist

Meryl De Geer, Dryden Shuttle coordinator

Bill Bastow, inspector

Ed Sabo, 747 crew chief



Bob Boyd, 747 night crew chief

Bill Szuwalski, aerospace engineering technician

Ski Markey, ALT facilities

Did You Know?

The U.S. Postal Service announced that a NASA project will be the subject of one of 11 commemorative stamp issues scheduled for 1978. During an as yet undetermined month, the successful conclusion of the Viking missions will be commemorated in a horizontal standard-size stamp. Data will continue to be received from the spacecraft on Mars until the spring of 1978.

Astronaut Jack Swigert (Apollo 13) recently announced his candidacy as Republication nominee for the seat held by the Democrat incumbent in Colorado. He joins Astronauts John Glenn and Harrison Schmidt in turning to politics as a career choice.

As of late October, **Voyager 1** was 39 million kilometers from Earth, cruising at a velocity of 40,190 km/hr relative to Earth, 45 days after launch. **Voyager 2,** 61 days after launch, is still ahead of its pursuing companion ship, 48 million km from Earth, cruising at 34,870 km/hr. One-way communications with the two craft from NASA's JPL take only a little more than two minutes.

Charles F. Hall, Pioneer project manager at the Ames center and **Dr. Christopher C. Kraft, Jr.,** director of NASA's Johnson center won National Civil Service Awards for 1976. Hall was a Special Achievement Award winner and Kraft won one of the Career Service Awards. Ceremonies took place in mid-November at the Smithsonian Institution's Museum of Natural History.

The North American Air Defense Command says there are now 4,472 manmade objects in space large enough to be detected and tracked. The agency recently estimated that figures could climb as high as 19,000 by the beginning of the next century. The command keeps tabs on what amounts to a manmade traffic jam circling in space. ■ ■ ■

Contractor News

International Business Machines, Federal Systems Division (Huntsville, Ala.) has been awarded a $1,344,950 contract through NASA's Marshall center for 134 site data acquisition subsystems. The subsystems will be used in the ERDA solar heating and cooling demonstration program to monitor the performance and collect data at sites throughout the United States for use in a national data program.

Lockheed-California Co., a subsidiary of the Lockheed Corp., has received a NASA government contract worth $270,000 to study the possibility of developing a liquid hydrogen-fueled aircraft capable of carrying 200 passengers at some 6,400 kilometers per hour. The contract is called a "very preliminary study."

General Electric signed a $5.6 million contract with NASA to build a special weather laboratory that will be carried into space by the Space Shuttle and its Spacelab in the early 1980s to study the causes of weather here on Earth. NASA chose General Electric to negotiate a contract for the work in June. The structure will be called the Atmospheric Cloud Physics Laboratory.

International Business Machines Corp. was awarded a $3.2 million contract by NASA's Kennedy center for the development of a test system that will check out Space Shuttle cargoes for their compatibility with the Shuttle orbiter before they are loaded into the payload bay. The system will simulate exactly the orbiter's electrical and electronic environment. Such a capability is needed because of the fast turnaround times planned for Shuttle missions.

The Boeing Commercial Aircraft Co. of Seattle has been awarded a NASA contract for the development of selected advanced aerodynamic and active control concepts for future civil transport aircraft. The contract, worth about $1.5 million, inludes six tasks having potential commercial transport application. The project will be managed by NASA's Langley center. ■ ■ ■

Marshall Center Director Honored by AIAA

Dr. William R. Lucas, MSFC director, has been elected a Fellow in the American Institute of Aeronautics and Astronautics. Notification of this honor, bestowed by current AIAA fellows, was received by Lucas from R. H. Miller, AIAA president. It was given, Lucas was told, "in recognition of your many outstanding contributions and acknowledged leadership in the professional aerospace community."

The organization will formally introduce Dr. Lucas as a fellow at the 14th AIAA Annual Meeting and Technical Display to be held Feb. 8, in Washington.

NASA Administrator Receives Outstanding Award

Dr. Robert A. Frosch recently was presented with the Gold Centennial Medal by the Engineers' Club of Philadelphia at ceremonies honoring the club's centennial year. He, in turn, presented the Engineers' Club with an autographed copy of a photograph of NASA Astronauts on the Moon.

The singular honor was recognized by President Jimmy Carter in the following letter, which was read at the ceremonial dinner in honor of the event:

"I send warm greetings to the members of the Engineers' Club of Philadelphia on the occasion of your Centennial celebration.

"I am pleased that you have chosen this occasion as the time and place to honor Dr. Robert A. Frosch with your Gold Centennial Medal. Dr. Frosch has had a distinguished career in both science and government. His public service has spanned several administrations and involved him in a variety of important endeavors. In each case he has made a notable contribution. I am proud to have him on my science and engineering team as the Administrator of the National Aeronautics and Space Administration.

"I join in your sentiments for him, and I extend my best wishes to each of you on this auspicious milestone."

Fred Brown, president, Engineers' Club of Philadelphia (center), presents Centennial Medal to NASA Administrator Frosch. At left is Charles Penrose, president of the Newcomen Society in North America.

Distinguished Visitor to JPL—Vice Admiral Samuel L. Gravely, Jr. (center), Commander of the Navy's Third Fleet and his aid, Lt. Cdr. Steven Letter, recently were briefed on NASA's Viking and Voyager missions, as well as the upcoming Seasat mission at NASA's Jet Propulsion Laboratory. Fred Felberg (left), assistant laboratory director of the office of technical divisions, and Dr. James King, manager of the user development program, accompanied the Vice Admiral on his tour of the NASA center.

Important Award to Lichty—Donald H. Lichty, director of NASA's administrative services division (center), recently was one of four government executives to win an Award of Excellence from the Association of Records Managers and Administrators and General Services Administration, National Archives and Records Service. The award is the highest tribute the organization can extend. Lichty was cited for ". . . keen interest and high professional competency in the broad spectrum of paperwork management . . . he has achieved cost savings to NASA aggregating over $1,500,000. Accompanying such savings have been better service and higher morale." Shown with Lichty at the annual awards luncheon are (left) Dr. James B. Rhoads, Archivist of the U.S., and Raymond Kline, NASA Acting Associated Administrator for Management Operations.

Mother-Daughter Satellites Launched

Two spacecraft were launched by a single rocket in October as part of a cooperative program by NASA and the European Space Agency to gain a better understanding of how the Sun controls the Earth's near space environment.

Called the International Sun Earth Explorers, (ISEE 1 and 2) the related satellites were launched Oct. 22 from the Kennedy Space Center into looping trajectories around the Earth, ranging in distance from 140,000 to 280 kilometers. The mission involves 117 scientific investigators, 35 universities and 10 nations.

Circling our planet for three years or more, the instrument-laden spacecraft are expected to provide detailed data on how solar wind particles control the boundaries between Earth space and interplanetary space. This will lead to a better understanding of a variety of solar-terrestrial phenomena, including weather and climate, energy production and ozone depletion in the atmosphere.

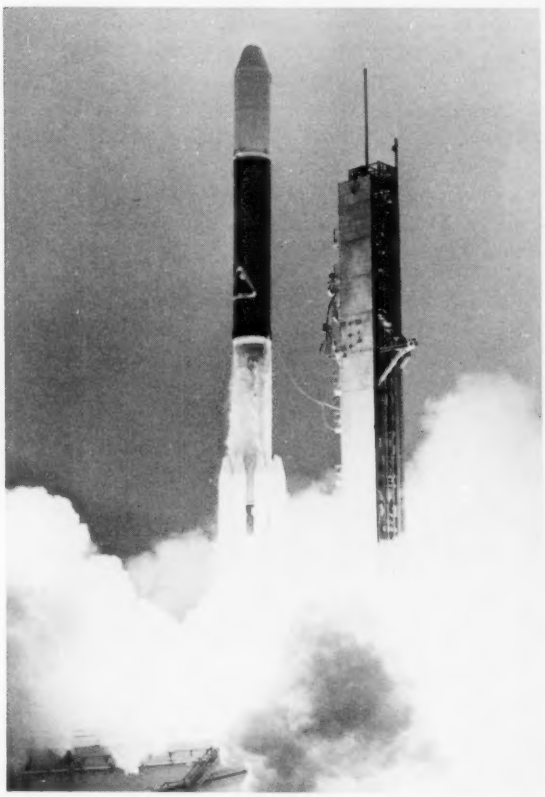
ISEE-1, managed by NASA, and ISEE-2 managed by ESA, are the first two spacecraft designed to be used together to investigate Earth's immediate space environment.

Shortly after third-stage burnout, when the two spacecraft attained the required trajectory, they were separated from each other but remained in the same orbit. The separation distance between ISEE-1 and ISEE-2 will be varied by the controllers between a few hundred to a few thousand kilometers during the lifetime of the mission.

For reasons of energy conservation, the smaller spacecraft, ISEE-2 (weighing 158 kilograms) will be the maneuverable spacecraft. The orbit of ISEE-1 will not be changed, but initially both spacecraft will undergo attitude maneuvers so that both are aimed at the same place in space. All maneuvers will be conducted by a NASA/ESA team at NASA's Goddard Space Flight Center.

The use of two spacecraft, separated by a variable distance, will allow scientists to study the boundaries in near-Earth space and the nature of their fluctuations. These include the plasma pause (the position at which there is a dramatic drop in the density of the magnetosphere, which is the magnetic envelope that surrounds the Earth); the magnetopause, where the magnetic field of the Earth meets that of the solar wind; the bow shock, a sort of bow wave created by the motion of the solar wind past the Earth; and several less obvious features of the Earth's magnetic tail. Measurements by instruments on a pair of spacecraft will permit ambiguities associated with the motion of these boundaries to be resolved.

In the past, a large number of phenomena measured by single instruments on spacecraft were not clearly understood. For example, did the sudden increase in energetic particles noted from measurements by one spacecraft come from an eruption on the surface of the Sun (perhaps a solar flare) or did it come from some other source? Perhaps the particles were suddenly released from the Earth's radiation belts or were bounced back from the bow shock front that extends hundreds of thousands of kilometers out from Earth. With two spacecraft at different points traveling on a similar trajectory and carrying similar instrumentation, time and space aspects associated with such problems can be solved.



Perfect Launch—At the Kennedy Space Center a Delta 135 rocket lifted off two International Sun Earth Explorer (ISEE) spacecraft last Oct. 22. Both craft will travel in high elliptical orbits around the Earth to study the magnetosphere and other near-Earth phenomena. NASA and the European Space Agency share in the launch and operation of the two satellites.

Even greater scientific returns will be possible when a third ISEE spacecraft is launched by NASA next summer to what is called the libration point—about 1.5 million km from Earth toward the Sun—where the satellite will remain.

The third ISEE in heliocentric orbit will obtain continual data on the fluctuating solar wind, and on special solar phenomena, such as solar flares, about an hour before the solar particles flow past the earlier ISEE-1 and 2 in Earth orbit.

In certain instances, this will provide Earth-bound scientists an opportunity to contribute through use of onboard instrumentation on the mother-daughter spacecraft to look for correlating phenomena. At the same time, sounding rockets could be fired from any global location on cue from the Goddard center at different launch areas around the world to investigate other aspects of onrushing solar wind. As part of a program called the international magnetospheric study, ground stations, sounding rockets, balloons, aircraft and satellites (including the ISEE spacecraft) will look at particular phenomena simultaneously from different parts of the Earth, including polar areas and space.

ISEE coordination is designed to fit into the IMS program, a worldwide three-year investigation that began in 1976. The three ISEEs are major contributions to the IMS by the U.S. and Europe. Data exchange offices have been established in Meudon, France, and Boulder, Colo. Meanwhile, a sophisticated satellite situation center at Goddard will calculate satellite orbits and publish results through the Boulder office. The published SSC orbits are designed for correlation with the various IMS systems to indicate when spacecraft data are likely to be especially plentiful and significant.

Much of the data returned by ISEE is expected to be of immediate interest in areas of practical application. For example, a growing mass of evidence suggests that events on the Sun (Sun spots, solar flares, high-speed solar wind streams) may affect our weather. Long-term variations of the Sun's energy output as well as more subtle changes in the solar wind and its magnetic field structure affect our climate. Is the Earth growing warmer or colder? Will certain parts get more or less moisture? Are severe storms and hurricanes in some way linked to solar mechanisms?

Solar and terrestrial exploration can help establish the physical cause and effect relationships between solar stimuli and terrestrial responses. When such relations are understood, a new tool will be available for weather and climate prediction.

The Earth's ionosphere and ozone layer, which protects us from dangerous solar ultraviolet rays, are influenced by solar events and conditions in the magnetosphere which these satellites will investigate. The ionosphere must be better understood because of the major impact it has on worldwide communications and precision navigation systems as well as the amount of global ozone.

Although numerous other spacecraft have been probing the magnetosphere since the early 1960's, the ISEE satellites carry instrumentation 10 times more sensitive than previously flown. Five years ago, the ISEE series could not have been flown simply because the required technology did not exist. As a result, much finely detailed information essential to understanding the range of Sun-Earth phenomena, the entire environmental system of Earth, and the interactions between the two is made possible by the ISEE spacecraft.

Earlier missions have shown that our space environment is most dynamic and exhibits changes more drastic than the weather patterns seen near the ground. These are precisely the changes that need to be studied, through use of instruments designed to operate in close coordination, to establish the complex interrelationships that control our "space weather."

ISEE-1 is a 16-sided polyhedron measuring approximately 1.73 meters across and 1.61 m high. Its main body consists of an 84-centimeter conical center tube, an aluminum honeycomb equipment shelf supported by eight struts. The lower end of the center tube mates with the launch vehicle and the upper end with the ISEE-2.

Certain exposed areas of the ISEE-1 and 2 spacecraft are coated with a conductive green paint developed at Goddard as passive electrical as well as thermal protection to keep the voltage buildup to no more than one to two volts, even as the ISEEs pass through the radiation belts.

ISEE-2 is a cylinder, with a diameter of 1.27 m and a height of 1.14 m. Solar cells are mounted on three detachable curved panels. An aluminum honeycomb platform supported by eight struts and center tube are the main load-carrying portions.

NASA is responsible for the ISEE-1 and 3 spacecraft, Delta launch vehicle, tracking and data acquisition and data processing. ESA is responsible for the ISEE-2 spacecraft and its operation.

The Goddard center will provide orbital computation, attitude determination and spacecraft control support to the ISEE missions during their planned three-year lifetime. ESA, in coordination with Goddard, is responsible for preparing, testing and

operating the ISEE-2 spacecraft and software for maneuver determination and computation.

ISEE-1 is a Goddard center design spacecraft built, fabricated and tested at Goddard with all its components either made at Goddard or supplied by industries or universities. ISEE-2 is an ESA-European Space Technology Center satellite whose design was determined through competitive concepts.

The STAR consortium of 10 countries supervised construction under contract to ESA. STAR consists of industries in Belgium, Denmark, France, Spain, Germany, Italy, the Netherlands, Sweden, Switzerland and the United Kingdom. Dornier Systems in Frederickshaven, Germany, heads the contractor team.

Goddard directs the Delta rocket program for NASA's Office of Space Flight and McDonnell Douglas Astronautics Co., Huntington Beach, Calif., is prime contractor.

Estimated cost of the two spacecraft and the scientific instrumentation is about $45 million, exclusive of launch and tracking and data acquisition costs.

Space Telescope Agreement Reached

The European Space Agency has signed an agreement with NASA for participation in the space agency's 1983 space telescope mission. A memorandum of understanding was signed on Oct. 7 in Paris by Dr. Robert A. Frosch, NASA Administrator, and Roy Gibson, Director of ESA.

Scheduled to be carried into Earth orbit by NASA's Space Shuttle, the space observatory will be used to study the universe with the highest possible resolution.

Under the agreement, ESA will provide a major scientific instrument and a spacecraft subsystem, participate in the in-orbit operation and maintenance of the telescope, and arrange for participation of ESA-sponsored European astronomers in the observation programs.

The scientific instrument to be provided by ESA is called the "faint object camera" to be used for high resolution imagery in the ultraviolet, visual and near infrared portions of the spectrum; the spacecraft system to be contributed is the solar array, to provide all power for the observatory.

The 2.4-meter diameter space telescope will be capable of accommodating up to five different instruments at its focal plane. It will weigh about 9,070 kilograms and will orbit the Earth at an altitude of about 500 kilometers above the obscuring effects of the atmosphere. Once placed in orbit, it will be operated remotely from the ground but will be designed to allow for maintenance and the change of instruments by a space-suited astronaut. It will be retrievable by the Space Shuttle for return to Earth for extensive overhaul and subsequent re-launch. These features should allow the space telescope to serve as an in-space astronomical observatory for more than a decade.

The space telescope is expected to help scientists to solve some of the mysteries relating to the structure, origin, evolution and energy processes of the universe —processes that defy solutions through use of observatories below the obscuring veil of Earth's atmosphere. The space telescope should allow astronomers to observe some 350 times the volume of space than can be seen now with the largest ground-based telescope.

NASA's Marshall Space Flight Center will have overall management responsibility for the space telescope. NASA's Goddard Space Flight Center will be responsible for managing the development of the scientific instruments and for the operational aspects of the observatory. The European effort will be managed by the European Space Technology Center at Noordwijk in the Netherlands.

NASA Noise Conference Held

Noise-Con 77, the third in a series of national conferences on noise control, was held in Hampton, Va., in October. Approximately 300 people attended the three-day meeting.

"Transportation Noise Control" is the theme of the conference, which is sponsored by the Institute of Noise Control Engineering and NASA's Langley Research Center.

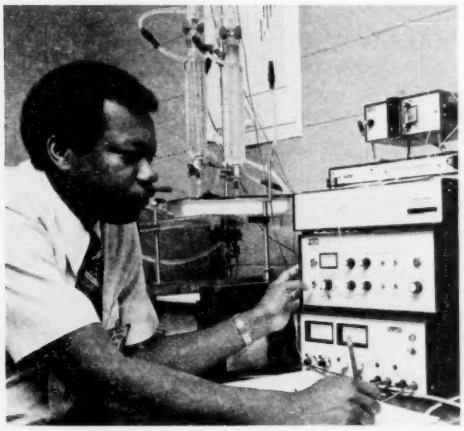
Some 40 technical papers were presented on how to control noise from railways, aircraft, motor vehicles and highways. Other papers discussed the community impact of transportation noise, standards and measurements and Federal government programs concerned with noise control. The papers were by representatives from several Federal agencies, private industry, universities and research institutes.

A three-day seminar on noise control preceded the conference, and two workshops took place during the conference, one on community noise problems and one on noise prediction.

Student Returns as Summer Faculty Fellow

A young scientist who 12 years ago was a student assistant under the first NASA research grant awarded to the Alabama A&M University served as a 1977 summer faculty fellow at the Marshall Space Flight Center.

Dr. Stanley L. Evans assisted in the first NASA research study assigned to Alabama A&M by the Marshall center's office of advanced technology in May 1965. The one-year study, entitled "Radiation Effects on the Metabolism of Phospholipids in the Central Nervous System of Albino Rats," was designed to involve college students in actual research study in a well-equipped laboratory.



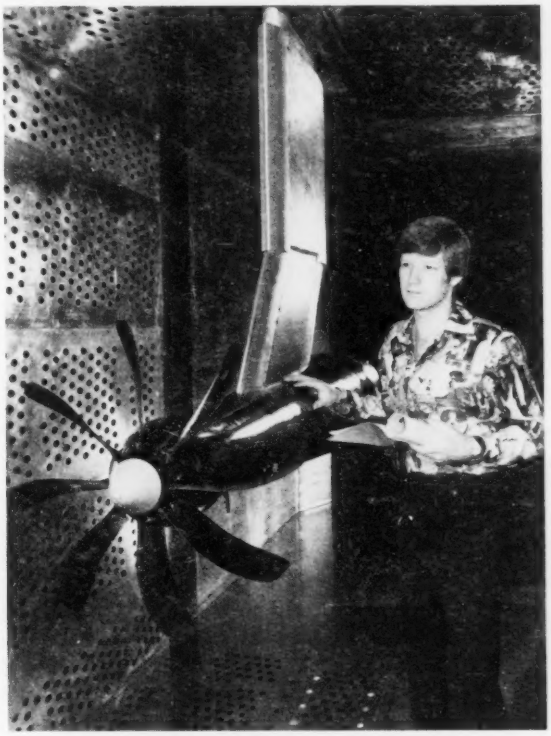
The 31-year-old scientist again conducted research for NASA, but this time as a well-known organic mass spectrometrist representing the Meharry Medical College in Nashville, Tenn., and the National Institute of Health in Bethesda, Md.

Evans was one of 23 college and university faculty members selected for the Aeronautics and Space Research Faculty Program conducted by NASA and the American Society for Engineering Education.

Assigned to the separation processes branch of the Marshall center's space sciences laboratory, Evans conducted research somewhat similar to his undergraduate work on cell separation. He and a group of researchers prepared and evaluated processes in which the advantages of zero-gravity can be used in separating and preserving cells for use on Earth.

A native of Mobile, Evans graduated from Alabama A&M with a B.S. degree in chemistry in 1968. He was named Alpha Phi Alpha fraternity's 1968 Man of the Year.

He received a master of science degree in chemistry from Fisk University in Nashville and, in 1975 a doctorate degree in organic chemistry and mass spectrometry from Harvard University. He received the 1971 Graduate School Award of Merit from Howard University.



Testing an Eight-bladed Propeller—Aeronautical engineer Robert J. Jeracki demonstrates a test model of the new eight-bladed propeller at the Lewis wind tunnel. The model is suspended from the top of the tunnel on a pylon.

Landsat to Measure Timber Resources

The St. Regis Paper Co. of New York and NASA have agreed to use NASA's Landsat spacecraft to demonstrate the technical and economic effectiveness of monitoring commercial timber resources scattered throughout a five-state area from 900 kilometers over the Earth. The Landsat data will be computer-processed into a forest resource information system to be used in the management of the St. Regis company's timberland reserves.

The Johnson Space Center will provide technical expertise in the development of an automatic classification system that can assess forested areas.

The objectives of the cooperative venture are: to identify kinds of trees, estimate timber volume and productivity, implement techniques to detect changes in the health and growth of the forests and integrate the new technology with existing operational data bases presently consisting of aerial photography and survey information.

Remotely sensed forest resource information (Landsat data) will be provided by the Johnson center through the laboratory for applications of remote sensing at Purdue University. LARS will be operating under a separate contact from the Johnson center. The St. Regis project manager will direct day-to-day operations of the experiment, expected to last through 1980. The NASA project manager will coordinate the LARS-Purdue and Johnson center technical efforts.

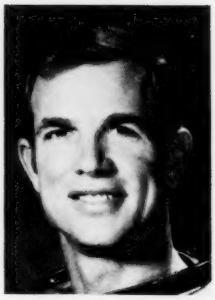
The land area to be surveyed as part of the experiment consists of forestland owned by the St. Regis Co. in Florida, Georgia, Alabama, Mississippi and Louisiana.

All software and techniques developed through this experiment will be considered in the public domain and can therefore benefit other forest resource managers as well as the St. Regis Company.

The experiment is the first major demonstration of its kind between a private company and NASA. Cooperative ventures exploring applications of Landsat and other remote sensors in the past have been conducted between NASA and other U.S. agencies or foreign governments.

Royal Observer of Space Shuttle—His Royal Highness, Prince Charles of Great Britain with David Scott (former director of the Dryden Space Flight Center) to his left and Lee Sherer, director of the Kennedy Space Center at far left. The occasion was the fifth free flight of the Space Shuttle orbiter at the Dryden center, Oct. 26, 1977.

Dryden Director Resigns



Dr. David R. Scott, director of the Dryden Flight Research Center since 1975 resigned from NASA Oct. 30 to enter private business in Los Angeles. Deputy director Isaac T. Gillam is serving as acting director until Scott's successor is announced.

Scott previously served as deputy director of the center from August 1973. He retired as a colonel from the U.S. Air Force in March 1975.

As a NASA astronaut, Scott flew on Gemini 8, Apollo 9, and was spacecraft commander of Apollo 15. When he left the Astronaut Corps in 1972, Scott was named technical assistant to the Apollo program manager at the Johnson Space Center. Later he served as special assistant for mission operations and government funded equipment.

On the Gemini 8 mission in 1966, Scott and Command Pilot Neil Armstrong performed the first successful docking of two vehicles in space. As command module pilot for Apollo 9 in 1969, Scott was instrumental in completing the first comprehensive Earth orbital qualification and verification test of a "full configured Apollo spacecraft." In 1971, he commanded Apollo 15, the fourth manned lunar landing mission.

Scott is a Fellow of the American Astronomical Society; Associate Fellow of the American Institute of Aeronautics and Astronautics; a member of the Society of Experimental Test Pilots, and of Tau Beta Pi, Sigma Xi and Sigma Gamma Tau.

Among Scott's special honors are two NASA Distinguished Service Medals, the NASA Exceptional Service Medals, the Air Force Distinguished Flying Cross, the Air Force Association's David C. Schilling Trophy and the Robert J. Collier Trophy for 1971.

Italian Medal Awarded Ames Center

NASA's Ames Research Center, whose two Pioneer spacecraft made the first trips to the giant planet Jupiter, has been awarded the Columbus Gold Medal by the city of Genoa, Italy in honor of two multi-billion-mile Pioneer flights.

Genoa, the birthplace of Christopher Columbus, presents the medal annually in connection with the annual celebrations there for "preeminence in courage, keenness and acuteness in research studies and achieve-

ments, audacity of realizations, tests of highly human significance, effective contribution to scientific advancement and dissemination of information thereof."

Clarence A. Syvertson, acting director of Ames, accepted the medal in Europe on Oct. 12.

Pioneer 10 flew past Jupiter in December 1973, returning the first close-up pictures of Jupiter and its planet-sized moons. Major scientific findings included assessment of the hazard of Jupiter's enormous radiation belts and determination that the giant planet, which has more than two thirds of the planetary material in the solar system, is an entirely liquid planet.

Pioneer 10 is now making the first trip out of the solar system. It carries an array of scientific instruments that can make more than 30 types of planetary and interplanetary measurements.

Pioneer 11 flew within 43,443 kilometers of Jupiter's surface, in December 1974, traveling faster than any previous man-made object. It took the first close-up pictures and measurements of Jupiter's polar regions, which are not visible from the Earth. Pioneer 11 now is making the first trip to Saturn, after which it, too, will leave the solar system.

At Ames, the pioneer project manager is Charles F. Hall and project scientist is Dr. John H. Wolfe.

Some 50 Ames people man the Pioneer project and 200 others at Ames worked part-time on the project. The two spacecraft were built by TRW Systems, Redondo Beach, Calif. Bernard J. O'Brien is TRW project manager. A total of 40 scientists from the U.S. and abroad worked on the project. Several thousand people at numerous firms and universities worked on sending the two Pioneers to the outer planets.

Turboprop Airplanes Could Make Comeback

Propellers, once thought of as obsolete for fast commercial aircraft service, could stage a comeback if research being conducted at NASA's Lewis Research Center is successful. The Lewis work is part of a NASA-wide aircraft energy efficiency program aimed at achieving as much as a 50 percent saving in fuel in aircraft manufactured in the future in the United States and also at retaining the dominant position of the U.S. in the world commercial aircraft market.

In the Lewis program, a group of small-diameter, eight-bladed propellers is being tested in wind tunnels to determine propeller operating characteristics at flight speeds up to 855 kilometers per hour and cruising altitudes above 9,145 meters.

Engineers estimate that at such speeds and altitudes, an advanced turboprop engine with the new design propeller will offer a 20- to 40- percent fuel saving over current turbofan engines and a 10- to 20-percent fuel saving over advanced turbofan engines.

Good results were achieved in the 1950s when airlines flew the then popular four-bladed propellers on turboprop engines. Those planes, however, flew at 645 km/hr and at a height of 6,095 m. To compete with today's commercial turbofan transports, an aircraft must have the capability to fly efficiently at 855 km/hr and 9,145 m cruise altitude. Advances in composite materials technology have made it possible to begin development of the strong, thin, short propeller blades necessary for efficiency at high speeds, Lewis propulsion engineers say.

The use of the new multi-bladed propellers offer the prospect of reduced fuel consumption at comparable cruise speeds, along with other advantages attributed to turbofan powered transports.

Materials Processing Experiments to Be Part of Early Shuttle Flights

NASA has selected five materials processing experiments to be packaged and flown on the Space Shuttle during one of its six orbital flight tests (OFT), providing scientists an interim opportunity to conduct investigations before Spacelab missions actually begin.

The experiment package, called the materials experiment assembly, will be first flown on one of the early orbital flight tests scheduled to begin in 1979. The package will be in regular use in later Shuttle flights on a space-available basis.

Experiments for the first MEA package were chosen because they could easily adapt to hardware available from the space processing applications rocket (SPAR) program and could be fitted into a compact assembly that requires no interface with the Shuttle except for one command from the cockpit to start the experiment processes.

Occupying a relatively small place, the MEA package will be automated and unattended. In addition to the experiment equipment, the package will contain its own power source and a mini-computer to collect data.

Tommy C. Bannister, management coordinator for the MEA project at NASA's Marshall Space Flight Center, said that in addition to the tremendous interest by scientists throughout the world in this early opportunity, it will be the first chance to try out a new low-cost packaging concept that omits extensive ground testing before flight.

"To design and assemble the MEA package so that we get good results from the experiments, using available hardware and omitting extensive ground flight tests, presents a challenge that excites us," Bannister said. "If we are successful in keeping costs down in this way and still get the data we want from the experiments, we will have reached an important milestone on the road to processing materials in space."

The space processing program began with five science demonstrations on Apollo missions 14, 16 and 17, and continued on Skylab and the Apollo Soyuz Test Project. The SPAR project, with sounding rockets, is now providing continued flight opportunities until the Shuttle and Spacelab become available. Each SPAR flight provides about five minutes of low-gravity time for experiments during the rocket's coast phase.

Principal investigators and experiments selected for the MEA project are:

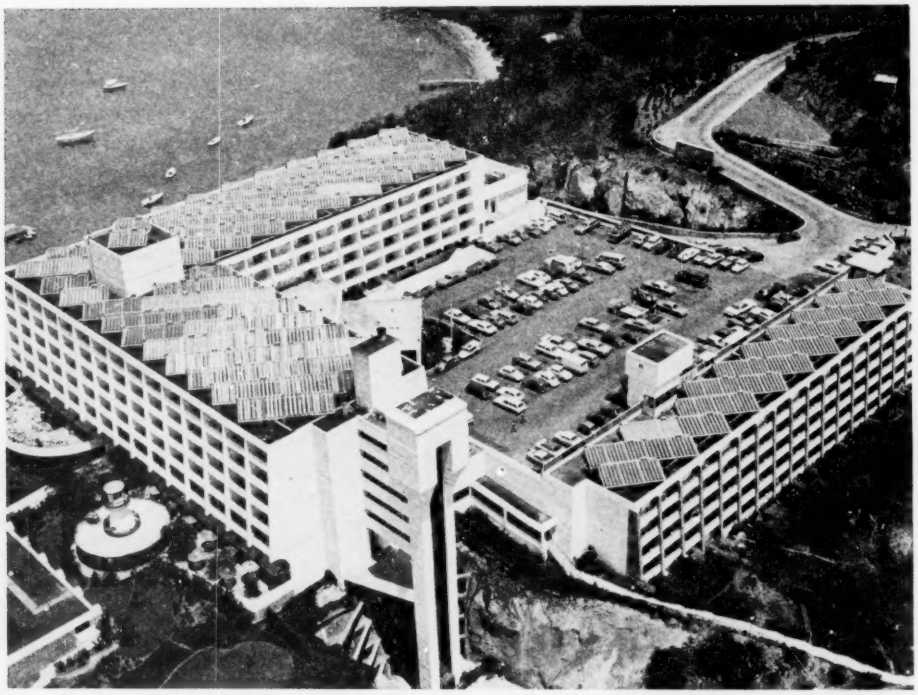
Dr. J. Bruce Wagner, Jr., Arizona State University —Solid Electrolytes Containing Dispersed Particles.

Ralph A. Happe, Rockwell International, Downey, Calif.—Containerless Preparation of Advanced Optical Glasses.

Dr. Herbert Wiedemeier, Rensselaer Polytechnic Institute, Troy, N.Y.—Vapor Growth of Alloy-Type Semiconductor Crystals.

Dr. John W. Vanderhoff, Sinclair Laboratories at Lehigh University, Bethlehem, Pa.—Large-Particle-Size-Monodisperse Latexes.

Dr. S. H. Gelles, Gelles Associates, Columbus, Ohio —Liquid Miscibility Gap Materials.



Immense Solar Energy System—An aerial photograph clearly displays the world's largest solar energy cooling system (described in the November *Activities*), recently completed at a St. Thomas (Virgin Islands) resort hotel. The half-million-dollar system is part of ERDA's national solar heating and cooling demonstration program, and one of 59 sites for which NASA's Marshall center is managing technical design and installation of solar heating, cooling and hot-water systems.

Patents for Inventions from NASA Research

The Office General Counsel, NASA headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer(s)	Title & NASA Docket	Patent No.	Installation
Richard Ravehall, Charles T. Salemme, Arthur P. Adamson } General Electric Co. Cincinnati, Ohio	Impact absorbing blade mounts for variable pitch blades	4,047,840	LERC
Otis S. Moreman, General Electric Co. Cincinnati, Ohio	Bearing seat usable in a gas turbine engine	4,046,435	LERC
Charles G. Miller, Jens G. Pohl, } NASA/JPL, Pasadena, Calif.	Three-dimensional tracking solar energy centrator and method for making same	4,046,462	NRLO
Edward H. Tepper, Hamilton Standard Division United Aircraft Corp., Windsor Locks, Conn.	Regenerable device for scrubbing breathable air of co2 and moisture without special heat exchanger equipment	4,046,529	JSC
John C. Freche, NASA/LERC William J. Waters, NASA/LERC	Nickel base alloy	4,046,560	LERC
Robert S. Snyder, NASA/MSFC Hans U. Walter, University of Alabama Huntville, Ala.	Method of crystallization	4,046,617	MSFC
Stephen H. Rice, NASA/GSFC Rodney S. Spencer, NASA/GSFC Charles M. Fleetwood, Jr., NASA/GSFC	Method of treating the surface of a glass members	4,046,619	GSFC
Roger L. Kessinger, Martin Marietta Corp., Denver, Colo.	Hearing aid malfunction detection system	4,049,930	PSC
David K. Studenick, NASA/GSFC	Fluid sampling device	4,046,012	GSFC
Bruce D. Marcus, George L. Fleischman } TRW Systems Group, Redondo Beach, Calif.	Flat-plate heat pipe	4,046,190	GSFC
Hubert C. Vykukal, Reginald F. King, Wilbur V. Valotton } NASA/ARC	Anthropomorphic master/slave manipulator system	4,046,262	ARC
Otis S. Moreman, General Electric Company, Cincinnati, Ohio	Deformable bearing seat	4,046,434	LERC

Graduation Ceremonies for Engineering Technicians—James P. Mitchell, deputy administrator at the Bureau of Apprenticeship and Training, U.S. Department of Labor, was the keynote speaker at the 33rd annual completion exercises for engineering technicians at NASA's Langley center in late October.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Restoring Old Photos—One of Many Uses for Autoradiography Processes

Old photographs, dimmed by the passage of time often can be restored to their original clarity by an autoradiographic procedure developed at NASA's Marshall Space Flight Center.

The process, originally developed to improve the image on underexposed astronomy photographs, also may be applied to underdeveloped or underexposed X-ray film.

Barbara Askins, a chemist at the Marshall center, developed the image enhancing process. "It is more difficult to predict success in restoring an old photograph than in enhancing astronomy and X-ray film because we can't trace the processing history for such things as kinds of chemical solutions used and methods of storage. For the scientific film we have those records available," she said.

Askins prepared an exhibit of old photographs that have been restored by the autoradiograph process which was on display at a Birmingham (Ala.) Museum of Art exhibit recently.

"Restoring old photographs is just one of several ways this process can be beneficial," Askins said. "It can enhance medical X-ray film that has been underexposed by as much as 80 to 90 percent. This means that the patient need not be subjected to X-rays a second time for the same thing.

"There are still a few problems to be solved before the process is widely acepted and used" she added. The two drawbacks right now are the high cost of the technique and the lack of an automatic processing method."

The process has potential for use in industry where X-rays are used to inspect welded parts and in the field of Earth resources for enhancing photographs made from aircraft and satellites.

Remarkable Restoration—An old faded photograph taken around 1908 of workmen at an Alabama construction site recently was restored to its original clarity and detail by a new autoradiographic process developed at the Marshall center. The process originally was developed for the enhancement of underdeveloped or underexposed astronomy photographs.

NASA
National Aeronautics and Space Administration